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worth note that on the whole the agreement as to the canals was greater than the agreement as to the broad features of the original drawing.

We consider Experiment 12 an exceedingly important one, particularly when taken in connection with certain experiments upon the limits of vision not here described. Objects near the limit of vision necessarily divide themselves into two great classes—dots and lines. Now the limit of vision for a straight line is such that if it be of reasonable length its breadth may be $\frac{1}{15}$ of the diameter of the smallest perceptible dot, and it will still be seen. It follows, therefore, that if the surface of *Mars* were really covered with a series of straight lines, like those represented in the charts which we owe to Professor Schiaparelli and Mr. Lowell, there could be no doubt, no controversy, about their existence. Every observer would see them. A straight line can be seen when its angular breadth is very far indeed below the limit of vision for any other form. Consequently when a drawing of *Mars* upon which actual canals were drawn was submitted to the boys they were practically unanimous in showing them with unhesitating distinctness and certainty.

Our conclusion from the entire experiment is that the canals of *Mars* may in some cases be, as Mr. Green suggested, the boundaries of tones or shadings, but that in the majority of cases they are simply the integration by the eye of minute details too small to be separately and distinctly defined. It would not therefore be in the least correct to say that the numerous observers who have drawn canals on *Mars* during the last twenty-five years have drawn what they did not see. On the contrary they have drawn, and drawn truthfully, that which they saw; yet, for all that, the canals which they have drawn have no more objective existence than those which our Greenwich boys imagined they saw on the drawings submitted to them.

It seems a thousand pities that all those magnificent theories of human habitation, canal construction, planetary crystallisation, and the like are based upon lines which our experiments compel us to declare non-existent; but with the planet *Mars* still left, and the imagination unimpaired, there remains hope that a new theory no less attractive may yet be developed, and on a basis more solid than "mere seeming."

Recent Observations of Mars and Jupiter. By W. F. Denning.

On 1903 May 19 and 21 telescopic definition was very good, and a considerable amount of detail visible on *Mars*, especially on the latter night. The *Syrtis Major* appeared abnormally dark and sharply outlined on both dates, while on May 21 a very

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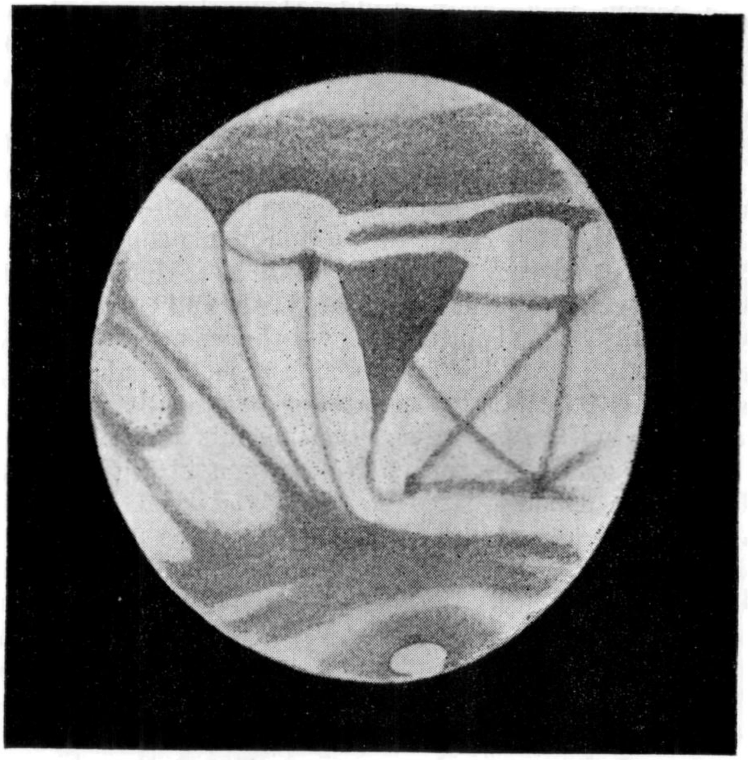
bright region crossed its southern extremity (separating it from the seas yet further south), and similarly bright areas lay over *Libya* to the west and north of *Sinus Sabœus* on the east. The best view ever obtained here of *Mars* was on the latter occasion when the configuration* was somewhat as follows.



May 21, 9h. Long. 281°·8.

On May 23 the planet was observed again at 8h 30m, 9h 15m, and 10h 30m, when, however, definition was not very satisfactory. The *Syrtis Major* exhibited a faintness and indefiniteness of outline which was immediately evident, and which quite astonished me after the experience of previous evenings. This marking, usually the most conspicuous object in *Mars*, had become extremely feeble, as if covered with highly reflective vapours which, though not sufficiently dense to wholly obliterate the object, had suffused it with a much lighter tone. In the early part of the evening the veiled aspect it presented might be accounted for, it being some distance from the centre and near the terminator; but at 10h 30m it had become nearly central, and was most difficult to trace even then. Bad definition could not have induced this effect, for a number of surrounding features,

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* The extreme delicacy of some of the features cannot be properly represented in a drawing of this nature, nor is it possible to include all the detail glimpsed at the best moments.

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normally less conspicuous than the *Syrtis Major*, were observed; and among these may be mentioned *Syrtis Minor*, *Amenthes*, *Boreosyrtis*, *Nilosyrtis*, *Coloe Palus*, &c. On the following night, May 24, between 9^h and $10^h\ 30^m$ the *Syrtis Major* remained feeble and indeterminate, though perhaps not in the same degree as on May 23. Definition, however, was unsteady, but certain other markings were fairly well seen during short intervals, when the seeing was good.

On subsequent nights the *Syrtis Major* came on too late to be suitably observed and a prevalence of easterly winds continued to impair definition. Several times, however—notably on May 25 and 27—a strikingly luminous zone was remarked north of the *Cimmerium Mare.* In fact, during the whole of the last half of May the brilliancy of an extensive belt ranging along the northern borders of *Cimmerium Mare*, *Syrtis Minor*, and *Sinus Sabœus*, was very strongly pronounced.

It seems possible that the bright material which on May 21 appeared to have collected over the equator and on the south side of the *Syrtis Major* may have drifted rapidly northwards and occasioned the faintness of that marking on May 23 and 24.

As affording a possible corroboration of the phenomenon alluded to, the *New York Herald* of May 31 contained a telegram from the Flagstaff Observatory mentioning that a projection had been seen on *Mars* on May 26 in latitude 22° north and longitude 37° west. "Professor Lowell says it must have been an enormous cloud travelling northwards and dissipating as it went. This deduction is proved by its non-appearance next day."

I had previously noticed on May 4 a probable instance of change in another region of *Mars*. The canal *Nilus*, running east from *Lunæ Lacus*, exhibited a very well-marked division. There was a bright, glowing spot attached to the east side of the very dark *Mare Acidalium*, and a stream of luminous material apparently flowed from this centre far to S.E., crossing *Nilus* and cutting through the dusky material forming the canal. On the following night the same aspect was repeated, but less decidedly. The division in *Nilus* had not been seen by me on March 31 or April 2, when the conditions were very good and the diameter of *Mars* ($14''\cdot6$) greater than on May 4 ($12''\cdot7$). Nor was this feature noticed in 1886 March and April, when I made several drawings of the same region.

A bright spot in *Elysium*, immediately on E. side of *Trivium Charontis*, was on many occasions observed as a striking pearl-like object when on or very near the edge of the disc; but when far inside the border or near central region the contrast was not nearly so strong. The intensification of the bright spots when on the margin of the disc has sometimes probably occasioned their recognition as "projections." The appearance alluded to is by no means a new feature. The bright spot described above as situated east of the *Mare Acidalium* was frequently seen by

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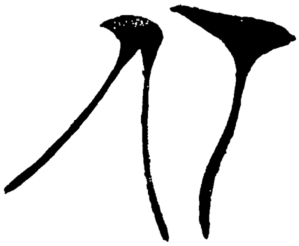
Mr. E. B. Knobel in 1873 May, and its position indicated in a number of sketches (*Monthly Notices*, vol. xxxiii. p. 476). Mr. Knobel says : "I thought the spot brighter on the terminator than when near the centre of the disc. The sketch made May 22 represents the white spot apparently raised above the disc by irradiation." Mr. N. E. Green also says : "One of the most marked features of the opposition of *Mars* now past has been the frequent appearance of masses of light on the limb which never arrived at the meridian" (*Monthly Notices*, vol. xlvi. p. 447, 1886 June).

With regard to the question of real or supposed changes in Martian detail we must obviously be prepared to make large allowances for variations in the character of the seeing, and it should be remembered that the observer himself is liable to certain perturbations which may materially affect his results. But while fully considering such influences I believe that very palpable alterations occur in the aspect of some of the features, though such variations are only temporary and due to atmospheric causes.

Some writers (including the Rev. E. Ledger, who has a paper on the subject in the *Nineteenth Century* for May) apparently regard the objective existence of the canals as still open to question, but there is really no doubt whatever about the streaked or striated configuration of the northern hemisphere of *Mars*. The canals do not appear as narrow straight deep lines in my telescope, but as soft streams of dusky material with frequent condensations. This statement holds good as regards the usual appearance of the more delicate features. But on a few occasions the canals, where they join the seas just south of the equator and cross the bright areas to be found there, were outlined very sharply. For instance on May 9 and 12 the canals running north from the region of the "Forked Bay" appeared under this aspect :—



The double canals are an optical effect only, though in a few cases two canals may lie near together and run almost parallel ; their contiguous situation appears, however, to be the result of accident. The surface lineaments generally are as plentiful as they are irregular and unsymmetrical, and their aspect is far more highly suggestive of natural than artificial production.

Jupiter was observed on the mornings of May 27, June 1, 4, 5, 6, and 7. A few selected transits were as follows :—

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		h	m	Long. °	System.
Great Red Spot	May 26	16	18	29·5	II.
„ „	May 31	15	28	30·4	„
„ „	June 5	14	33	28·3	„
P. end dark mass, S. tropical zone	June 6	15	16	204·5	„
Very bright equa. spots	June 3	15	19	268·1	I.
	June 6	14	49	3·4	„
Very dark equa. spot	June 3	15	0	256·5	„
Dark N. tropical spots	June 3	14	45	95·1	II.
	June 3	15	28	121·0	„
	June 3	16	1	141·0	„
Dark N. temp. spot	May 26	15	38	5·3	„
	May 31	14	50	7·4	„
Dark N.N. temp. spot	June 6	15	12	202·1	„

The accelerated motion of the Great Red Spot has been continued for this object, has lost about 8° in longitude since 1902 December (when it was 37°), and this corresponds to a rotation period of $9^{h}\ 55^{m}\ 38^{s}{\cdot}8$. The large dark spot in the S. tropical zone, frequently observed in 1901 and 1902, is still prominently visible, and its p. side will be in longitude 185° at the middle of 1903 July.

In the various observations here described a 10-inch reflector was employed with a power of 312, but occasionally on *Mars* magnifiers up to 488 were found serviceable.

Bishopston, Bristol: 1903 *June* 7.

Postscript.—From my subsequent observations of the Great Red Spot on *Jupiter*, including one obtained on July 13, $16^{h}\ 2^{m}$, when the object was in longitude 32°·8, it appears certain either that the motion has been recently retarded or that my transits at the end of May and beginning of June were a little too early.

July 14.

Observations of the Satellite of Neptune from Photographs taken at the Royal Observatory, Greenwich, between 1902 *November* 12 *and* 1903 *April* 27.

(*Communicated by the Astronomer Royal.*)

The following measures of position-angle and distance of *Neptune's* satellite were made from photographs taken with the 26-inch refractor of the Thompson Equatorial. The occulting shutter was used when not otherwise noted, and the position of